Interactions between extensional shear zones and syn-tectonic granitic intrusions: the example of Ikaria Island (Cyclades, Greece)

Valentin Laurent, Alexandre Beaudoin, Laurent Jolivet, Laurent Arbaret, Romain Augier, Aurélien Rabillard

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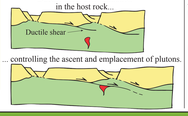
1) Introduction

The **goal** of the present study was to investigate the **interactions between syn-tectonic granites and Metamorphic Core Complexes (MCCs) development**. Two different models were described:

- Model 1: Shear zones control the ascent and emplacement of plutons.
- Model 2: Emplacement of plutons allow the initiation of shear zones.

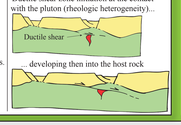
Model 1: Brown and Solar (1998a)

Shear zones control the ascent and emplacement of plutons.



Model 2: Neves et al. (1996)

Emplacement of plutons allow the initiation of shear zones.

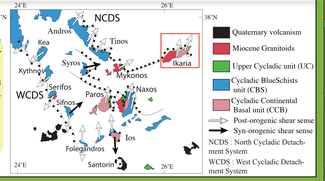


2) Geological setting

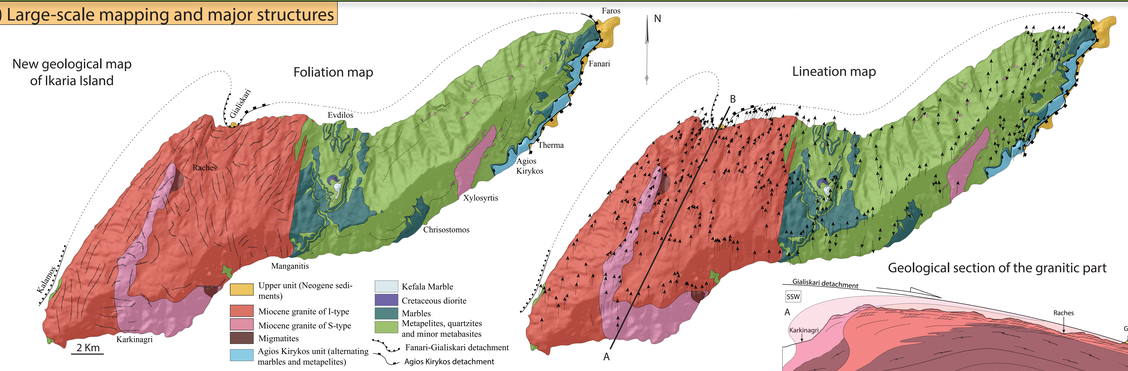
The Aegean domain is an ideal place to investigate the development of MCCs and to study the role of syn-tectonic granites on their development.

Cycladic islands are located in the center of the Aegean domain and correspond to the deepest exhumed part of the Hellenides-Taurides chain. **Three tectonic units** are recognized in the Cyclades:

1) the Upper Cycladic unit (UC)
2) The Cycladic BlueSchist unit (CBS)
3) The Cycladic Continental Basal unit (CCB).



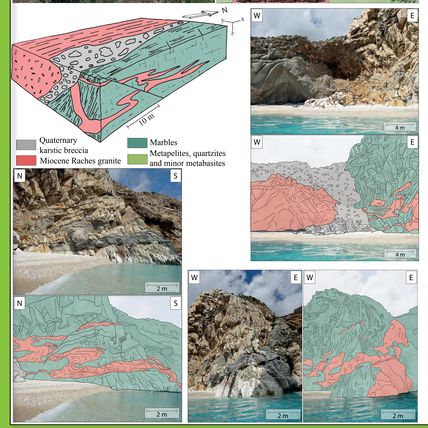
3) Large-scale mapping and major structures



A new field study of the granitic plutons of Ikaria Island (Cyclades, Greece) was conducted and resulted in the proposition of a new geological map. Our survey shows **three major structures** :

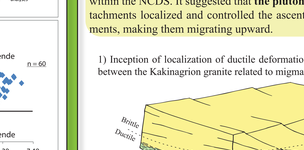
i) The **intrusive contact between the Raches granite and the metamorphic dome**, in opposition to a tectonic contact like described by Photiades (2002a), Kokkalas and Aydin (2013) or Kumerics et al. (2005).

i) Contact between the Raches granite and the metamorphic units

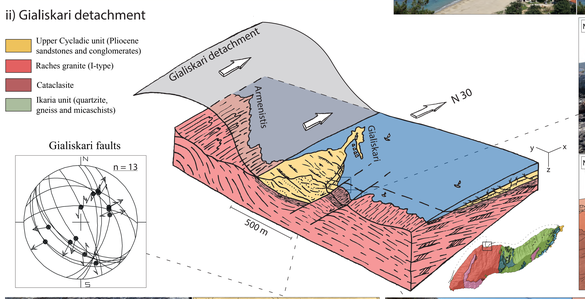


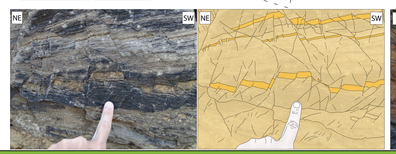
ii) The **Gialiskari detachment.**

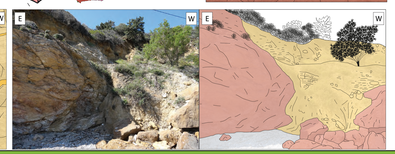
iii) The contact between the Raches and Karkinagrion granites. Our new mapping, reveal a **much larger volume of the Karkinagrion granite** than previously described by Ring (2007) and Bolhar et al. (2010a). We also highlight the presence of **migmatites related to the Karkinagrion granite**. These observations led to redefine the nature of the contact between these two granites described by Bolhar et al. (2010a). It rather seemed that the **Raches granite intruded the complex migmatites-Karkinagrion granite** and not the opposite.



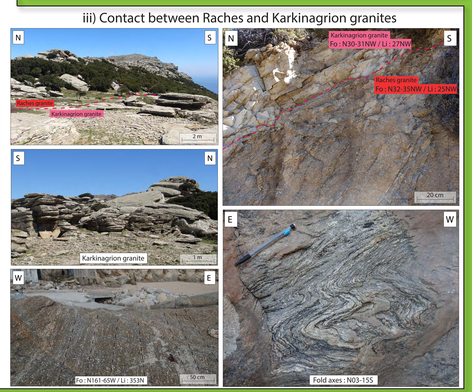
ii) Gialiskari detachment







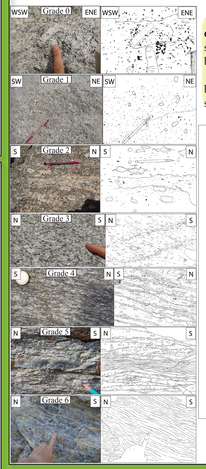
iii) Contact between Raches and Karkinagrion granites

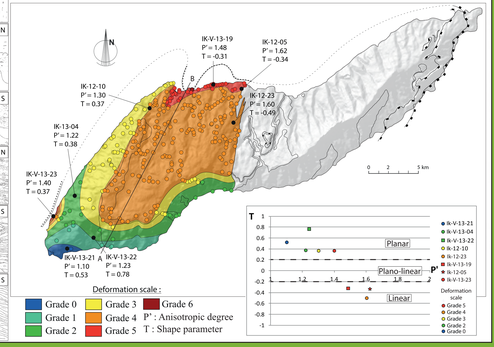


4) Distribution and quantification of ductile deformation

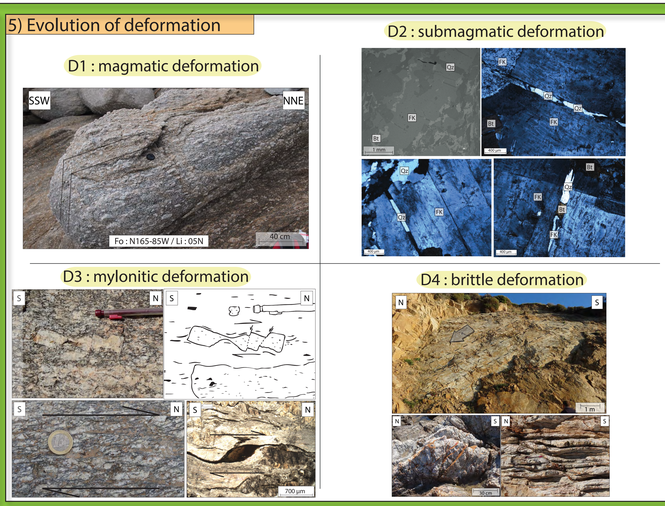
The Raches and Karkinagrion granites show intense ductile deformation. In the field, a **gradient of strain** has been observed **from south to north**. In order to characterize this gradient, we used a scale of ductile deformation intensity, divided into **seven grades**. Each grade of deformation was based on **macro-structural criteria** adapted to fieldwork.

In addition, we have reconstructed by image analysis the strain ellipsoid of the Raches granite based on the **shape fabric of biotites**. A good correlation was observed between the degree of anisotropy (P') and the quantitative map of deformation elaborated in the field.



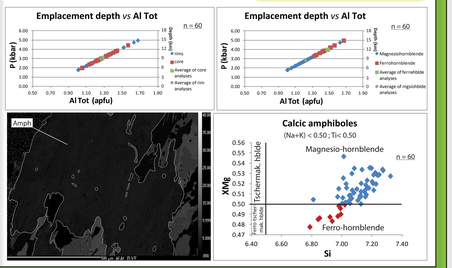


5) Evolution of deformation



6) Al-in-hornblende barometry

Raches granite emplacement ≈ 12 km

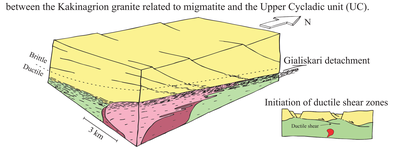


7) Discussion and interpretation

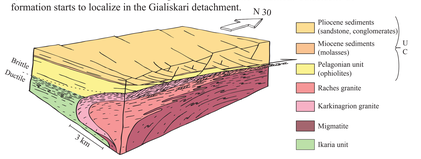
The **objective** of this work was to study interactions between syn-tectonic granites and MCCs development. Based mainly on field observations, we conclude that the **Karkinagrion and Raches granites emplacement postdated the initiation of the Ikaria MCC**. While the exhumation of the metamorphic dome involved the Agios Kirykos detachment during the first stages, the plutons intruded this detachment and deformation migrated upward when granites were emplaced.

This complex interaction between detachments and intrusions were found also on **Tinos and Mykonos** within the NCDS. It suggested that **the plutons did not initially localize detachments**, instead that the detachments localized and controlled the ascent of the plutons. The intrusions then interacted with detachments, making them migrating upward.

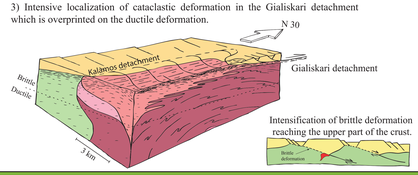
1) Inception of localization of ductile deformation within the Gialiskari detachment located between the Kakinagrion granite related to migmatite and the Upper Cycladic unit (UC).

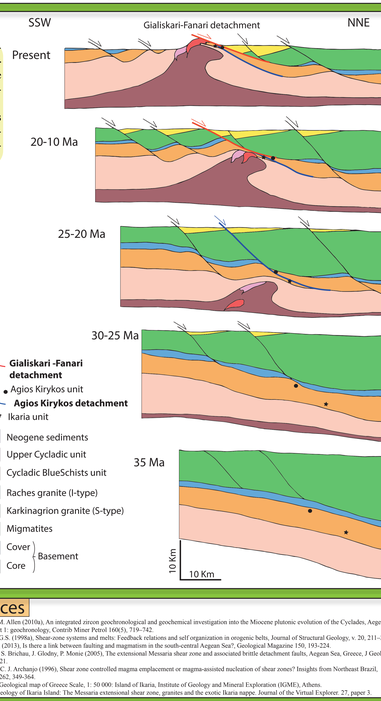


2) Evolution of the deformation through the brittle-ductile transition. Cataclastic deformation starts to localize in the Gialiskari detachment.



3) Intensive localization of cataclastic deformation in the Gialiskari detachment which is overprinted on the ductile deformation.





References

Bolhar, R., U. Ring, CM. Allen (2010a), An integrated zircon geochronological and geochemical investigation into the Miocene plutonic evolution of the Cyclades, Aegean Sea, Greece: part 1: geochronology, Contrib Miner Petrol 160(5), 719–742.

Brown, M., and Solar, G.S. (1998a), Shear-zone systems and melts: Feedback relations and self organization in orogenic belts, Journal of Structural Geology, v. 20, 211–227.

Kokkalas, S., A. Aydin, (2013), Is there a link between faulting and magmatism in the south-central Aegean Sea?, Geological Magazine 150, 193-224

Kumerics, C., U. Ring, S. Brichau, J. Glodny, P. Monie (2005), The extensional Messaria shear zone and associated brittle detachment faults, Aegean Sea, Greece, J Geol Soc, 162, 701–721

Neves, S., A. Vauchez, C. J. Archanjo (1996), Shear zone controlled magma emplacement or magma-assisted nucleation of shear zones? Insights from Northeast Brazil, Tectonophysics 262, 349-364.

Photiades, A. (2002a), Geological map of Greece Scale, 1: 50 000: Island of Ikaria, Institute of Geology and Mineral Exploration (IGME), Athens.

Ring, U. (2007), The Geology of Ikaria Island: The Messaria extensional shear zone, granites and the exotic Ikaria nappe. Journal of the Virtual Explorer. 27, paper 3.